DVCS at HERMES

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Abstract

This talk explores the impact that the HERMES experiment has had regarding knowledge of the Deeply Virtual Compton Scattering process. We discuss the various measurements that HERMES has contributed to the library of DVCS knowledge [1–3], with focus in particular on the recent high-precision beam spin and charge asymmetries [4].

1 Introduction

The HERMES experiment was a fixed-target experiment on the HERA ring in Hamburg, Germany. The experiment ran from 1995-2007 and used the 27.6 GeV electron/positron beam made available by the HERA accelerator. A variety of polarised targets were used; the targets under consideration in these proceedings were transversely polarised (w.r.t. the beam direction) and polarisation averaged proton targets. In this work we discuss some of the DVCS measurements taken by HERMES.

2 Exclusive Physics

Knowledge of nucleon structure can be expanded by considering generalised parton distributions (GPDs); access to GPDs can be achieved by measuring particle production in scattering processes where the target nucleon remains intact. The simplest process to understand is Deeply Virtual Compton Scattering (DVCS), where a photon is produced by a parton from the nucleon [1, 2, 3, 4, 5]. It is also possible to interpret measurements of produced mesons in the GPD framework, e.g. [6, 7, 8, 9]. The HERMES experiment recently produced DVCS measurements from the entire 1995-2007 data set, where beam helicity and charge azimuthal asymmetries in the produced particle distributions are measured, see figures 1 and 2 respectively. In these figures the measurements are compared to values from a lightcone wavefront partonic model [11] and from a flexible bag model [12]. Both of these models

receive input from PDF measurements and form factors. The former is also fit to a large subset of the available world data, whereas the latter's skewness dependence is determined solely from measurements made at Halls A and B at Jefferson Lab. The HERMES experiment can distinguish the pure DVCS contribution to the asymmetries from the contribution due to the interference with the competing Bethe-Heitler process due to the presence of both beam charges in the data set. These measurements are taken with a missing-mass selection technique, where the target nucleon scatters outside the HERMES geometric acceptance and must be reconstructed from measurements of the produced photon and scattered lepton. This event selection technique allows a certain amount of background into the data sample, mostly from events involving a resonant state of the target nucleon. The collaboration has also published measurements from a kinematically completely recostructed data sample [10] that was taken with additional experimental equipment — these measurements are discussed in other contributions to this conference. Both figs. 1 and 2 show strong twist-2 amplitudes; in particular fig. 1 implies a steep drop-off of $A_{LU,I}^{\sin(phi)}$ at small values of t as the amplitude must become zero-valued at the point $t = 0\,\mathrm{GeV}^2$ as a matter of definition.

Acknowledgements

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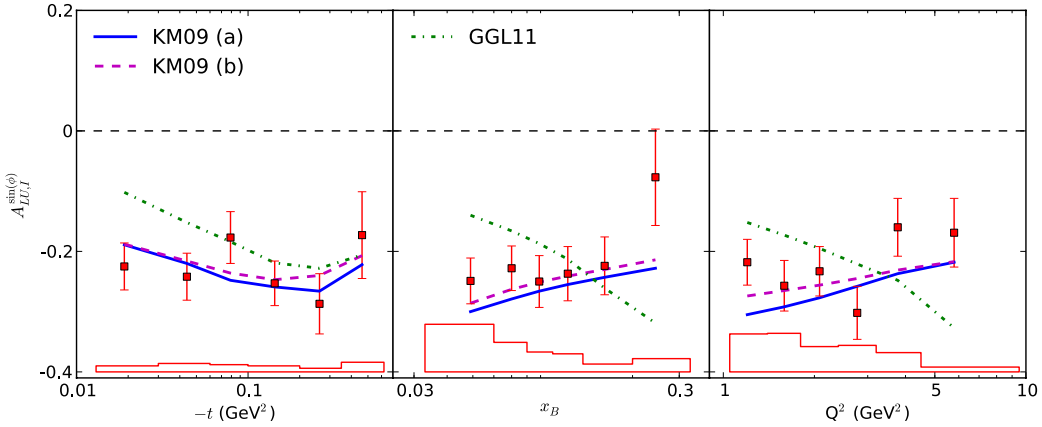

Figure 1: The interference contribution to the first harmonic of the beam helicity asymmetry projected in six bins along the three kinematic dimensions $-t$, x_{B} and Q^2. This measurement can be used to constrain a part of the GPD H, the generalised parton distribution that reduces to the parton distribution $q(x)$ in its forward limit. Error bars are the statistical uncertainties; error bands are the systematic uncertainties. The curves on the figure come from [11] and [12].

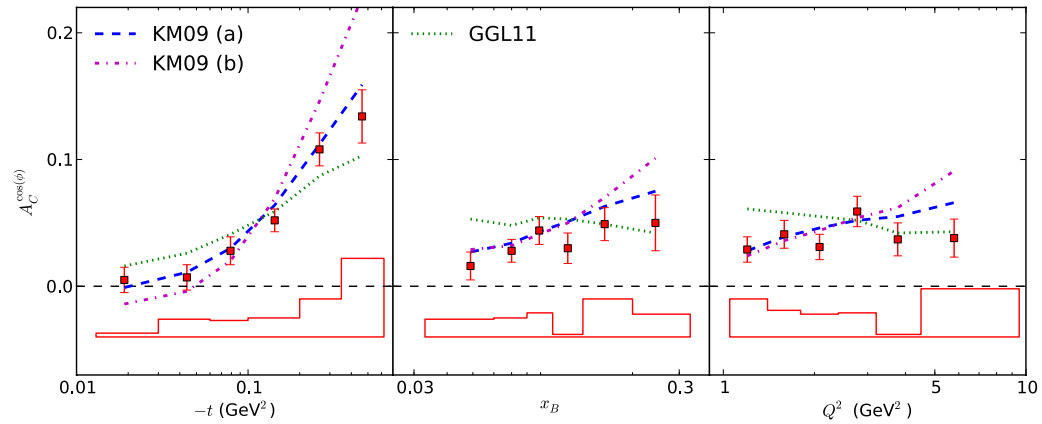

Figure 2: The DVCS and interference contributions to the first harmonic of the beam charge asymmetry. This measurement can be used to constrain a part of the GPD H, the generalised parton distribution that reduces to the parton distribution $q(x)$ in its forward limit. The curves on the figure come from [11] and [12].

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